# THE TECH ENGINEERING NEWS

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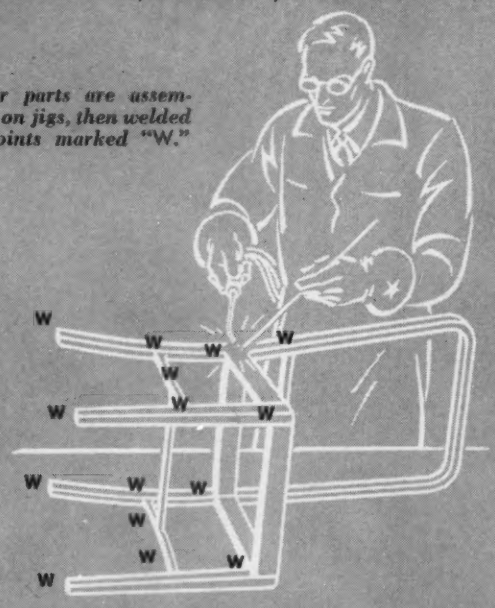


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# OUR AUTHORS

**JOHN LLEWELLYN LEWIS** was born in Lucas, Iowa, in 1880, and was educated in the Public Schools. Early in life he became interested in the cause of labor, and his rise to the leadership of the national labor movement was meteoric. In 1909 he became a legislative agent of the United Mine Workers of America; from 1911 to 1917 he was a representative of the American Federation of Labor; during the years 1917 and 1918 he was elected Vice-President of the United Mine Workers; and since 1920 he has been the President. He is a member of the Labor Advisory Board, as well as the American Academy of Political and Social Sciences. He was formerly connected with the National Labor Board of the N. R. A. Recently, he was elected General Chairman of the Committee for Industrial Organization, and figured largely in the settlement of the steel and auto strikes. His home is in Springfield, Illinois.

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# THE TECH ENGINEERING NEWS

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**MODERN MOLES**

# TECHNOLOGY and LABOR

JOHN L. LEWIS

TECHNOLOGY, as I understand the word, means the application of the sciences to the industrial arts. In this sense of the word, no group of persons in the United States is more vitally concerned with technology than is organized labor. There are two reasons for this interest: First, labor is well aware that improvements in industrial techniques have made possible a rising standard of living for the workers in the past, and hold promise of higher and higher standards in the future; second, labor is equally well aware that sudden and radical technological changes may result in the complete loss of jobs to particular workers or groups of workers. In other words, technology, with one hand, offers a constantly fuller dinner pail, but, with the other it may empty many individual dinnerpails of what little they already contain.

Here is the great anomaly of the present day. We cannot dispense with the gifts of technology without giving up hope of a constantly improving way of life for the vast majority of our people. At the same time, we cannot be blind to the fact that, undirected and uncontrolled, the amazing progress of the industrial arts may create such widespread displacement of labor as to endanger our whole social system.

It would be fascinating, if space permitted, to trace the progress and effects of technology throughout the ages. The man who built the first cart on wheels, and thereby made it possible for a horse or an ox to drag a far heavier burden than it could carry on its back, made the first important contribution to the technology of transportation. His discovery also has important social implications. It reduced the cost of carriage and thus made for lower prices and better living standards; it enlarged the sphere of mass travel, and, thus, for good or for evil, brought communities into closer contact with each other; and it created such new occupations as carter, and such new trades as cart maker, wheel wright and harness maker.

Similarly, when Benjamin Franklin constructed a simple, box-like iron stove, he not only made housekeeping easier and more comfortable; he also pointed the way to the coal-burning stove and furnace, and thus in turn helped to lay the foundation of the great coal industry, with its hundreds of thousands of specialized workers.

For the most part, these earlier technological developments were too infrequent and on too small a scale to have any immediately serious effect on the social order. It was only with the advent of the power machine and its widespread application in the early part of the 19th century, that technology may be said to have first come into serious conflict with the social structure.

Its first fruits were in England. Here the rapidly expanded textile industry took the workers out of their home workshops and put them in factories. Then the demand of the growing factory industry for fuel led to the exploitation of the coal lands with the most distressful results among the men, women and children who were taken from farm and village life to labor underground.

These particular developments are usually referred to as constituting the Industrial Revolution. It was also a Social Revolution. The whole life of England was profoundly changed. There came into existence for the first time on a large scale a class of powerful industrialists and a class of industrial wage-earners.

In the United States the effects were less immediate, partly because we were for a long time primarily an agricultural people, and partly because the vast free land of the West offered an outlet to the displaced and the dissatisfied. But with the turn of the present century the free lands were exhausted. This, with a tremendous quickening in the industrial arts and sciences, led to the present sharp conflict between technology and the worker in so many lines of industrial employment.

There have been many casualties in this conflict. Millions of workers have been displaced, and have either found no other work or have been forced to accept anything offered, at a sacrifice of their accumulated skills and earning power. Still worse, perhaps, those who have not actually suffered as yet, see the effects of changed technical processes upon their fellows. Witness, for instance, the recent introduction of automatic continuous rolling mills in certain steel plants. These mills employ practically no labor, and their emptiness of human beings is a constant reminder to the workers in other mills of what may happen to them.

So widespread is this feeling of uncertainty, amounting often to fear, that there are few, if any, skilled workers in the United States who have any real confidence in the continuance, not merely of their present jobs, but even of any jobs anywhere requiring their particular types of skill and experience. Nor is this feeling of uncertainty for the future limited to the wage earners. It exists among many salaried workers and members of the professional classes, and extends even to the farmers.

Farming, indeed, is one of the industries most seriously affected by modern discoveries in chemistry and physics, as well as by mechanical inventions. The combine-harvester and similar machines immediately displace thousands of farm laborers, and the few laborers still needed are mechanics, capable of operating and maintaining expensive machinery, and not those with a knowledge of farming. This change is evident to all. Less evident, even to those immediately concerned, is the effect of these improved methods upon the farmer himself, for in the long run the small independent farmer cannot compete with the "mechanized farm" any more than the little steel maker can compete with the big steel corporations.

This atmosphere of uncertainty and fear is most unfortunate. The caste system of older days and older countries, where trades were automatically handed down from father to son, has always been repugnant to our American sense of democracy and free enterprise. But the present situation, with its universal lack of security — with the father advising his children not to follow in his footsteps — is repugnant to our common sense.

Labor, of course, is not unaware of the argument that the displacement of labor, through technical improvements in industry, is only a temporary phenomenon. The argument runs like this. Improved machinery means lower prices, and the savings thus given the consumer are available for the purchase of other commodities, which, in turn, demand more labor to produce.

The fallacies in this argument are twofold. First, prices do not automatically reduce themselves with lowered production costs. Prices are determined by many factors, and everyone, except the confirmed classical economist, knows that, even

when prices do reflect reduced costs, there may be a long "time lag" before this occurs. And, second, labor is not a fluid, flowing from where it is not wanted to where it may be wanted, without loss or friction. Labor, on the contrary, is just a conglomerate of human beings, with the ordinary human craving for food, clothing, shelter, and family life. Thus, if a machine displaces ten skilled lumber workers in Seattle, the fact that, simultaneously, there are openings for ten skilled tailors in New York City, is no help to the ten jobless lumber workers in Seattle. In the first place, they probably would know nothing of the New York jobs; secondly, they probably couldn't afford to travel that far; and thirdly, even if these two serious difficulties could be overcome, the unemployed lumbermen couldn't qualify for the jobs offered. This, of course, is an extreme case, but broadly speaking, it illustrates what has been happening to American labor.

What is to be done about this situation? There can be no answer in a single sentence, nor even probably in a single volume. The accumulated problems are so far-reaching and affect so many phases of our life that the efforts toward solution will necessarily involve many forms of remedial action, political and even psychological as well as economic. I will content myself here with suggesting only certain broad lines of approach.

First of all, the workers must be assured of receiving a fair participation in the increased productivity of industry due to technological changes. Scientific progress must be treated as a social asset, not as individual property. The inventor, of course, should be suitably rewarded. Management and capital should also be properly compensated. This is proper and just. But, a fair portion of the surplus should go to the workers whose skill and labor make all industry possible. Otherwise there can be no real progress for the great mass of mankind. This is sound ethics. It is also sound business sense, for unless wages steadily increase there will be no market for the output of our marvelously efficient production machine, and industry will stagnate with its warehouses full.

Second, our social security schemes must be liberalized. The existing unemployment insurance laws, for instance, provide for benefit payments over a few weeks only. This is helpful in short periods of unemployment, but it fails utterly to meet the problem of unemployment due to technological displacement, which only too often means months of unemployment and also often requires retraining for other work and transfer to other communities.

Third, there must be a strengthening of labor union to the point where the workers in every major industry are organized units, capable of defending themselves against injustice, but also capable of lending their assistance in the efforts to solve the problems of industry. For it is a serious blunder to think of the trade union as merely a militant organization, seeking higher wages and shorter hours. As far as it is militant, it is so simply because of the unreasonable and violent opposition by organized employers to the exercise by labor of a similar right to organize. Fundamentally, the labor union is a force for conserving all that is good in industry and in assisting industry to improve its technical processes. Labor's stake in the efficient conduct of industry is just as great, perhaps even greater, than is that of management or capital.

Lastly, the processes of technology must be directed with a view to their social consequences. It is desirable that this direction should come from industry itself, acting in cooperation with labor.

But, the State, of course, has a vital interest in the matter and must have an advisory voice, at least. This was implied in the recent report of the National Resources Board on the subject of technological changes. Also, the technologists themselves, and the schools of technology, have an important part to play. They must concern themselves more and more with the economic and social aspects of their work and not limit their vision to the purely scientific aspects.

They must remember that a new machine, or a new discovery in chemistry or physics, may, unless properly controlled, be as devastating as poison gas. In a perfectly organized economy, where service and not profits was the governing motive, this would not be the case, but in a profit economy such as ours there is no surety that the sudden growing of "two blades of grass where only one grew before" will be a social good. For instance, the invention of an efficient cutting and harvesting machine for sugar cane would, from the technical standpoint, be a marvelous achievement. To Cuba, however, it would mean absolute destitution for the great mass of native laborers, and therefore might be a calamity to the State.

The technician therefore has a heavy responsibility. In the past, unfortunately, the technical brains of the country have been almost entirely in the service of the industrialists, whose interests are in immediate profits and, with a few notable exceptions, are little concerned with long range human consequences. In the future, it is to be hoped that more and more of this technical intelligence, particularly on the part of younger graduates, will be in the service of the State and of organized labor.

The unions, I am convinced, have an increasingly important part to play in the intellectual guidance of industry in the future, and can make profitable use of young men and women learned not only, as the old books say, "in the sciences and industrial arts," but also animated with the desire to make America, through the intelligent application of technological improvements, a better and a happier country for all groups of our population.

The great problem which organized labor has before it today is to democratize or convert to the social welfare the operations of the machines, and the wonderful technological processes and improvements which modern scientific research and invention have developed. Our constant gains in productive accomplishment must be widely diffused and made to contribute to the economic well-being of all stratas of our people. In solving this fundamental problem, organized labor hopes that it will have the cooperation and expert assistance of all engineers and technicians in the industrial field.

In a restricted, practical way, that is, in the form of wage payments, this problem is already being met. In the bituminous coal mining fields, for example, the advent of coal-loading machines has led to an agreement between the operators and the United Mine Workers to study the increase in productivity produced by these inventions, and the men displaced, as well as the reduction in costs per ton of coal mined. Both the Union and the operators have retained engineers to make technical investigations along these lines. Later, the results of these studies will be brought together, and through a conference between technicians and the parties in interest, it will be determined to what extent the mine workers may be permitted to participate in the results obtained from these new inventions.

On the other hand, if we turn to the manufacturing industries, we find in automobile manufacturing, the highest example of modern mass-production. An agreement recently made between the General Motors Corporation and the United Automobile Workers provides that the established speed of individual machines, or of conveyor systems, is ultimately a matter of scientific study and agreement between the union and the corporation.

Engineers and other technicians on graduation from schools in the future will undoubtedly find a growing field for human and social service in the organized labor movement, in addition to the traditional field of employment in industry itself.

# Scientific Research

## *It Provides the Proper Educational Atmosphere at Technology*

O. G. C. Dahl

FROM the earliest times the spirit of inquiry has been the dominant force in promoting real progress. In fact, the mile posts of scientific development have been erected by individuals who possessed this spirit in a pronounced degree and who had the courage of their convictions to present the truth as they saw it in the face of scepticism, criticism, and even threat of physical punishment. These men were *researchers in the true sense of the word.*

***This article should be of especial interest to the incoming student because of its summation of the Institute's policy in regard to research. It was adapted from the orientation lecture, "Research Projects in the Institute," delivered to the Electrical Engineering Sophomores on May 7, 1937.***

How should we best define research? I believe a number of definitions can be found in the literature, but the one which appeals the most to me is the following: "Research is an organized effort to acquire new knowledge." I do not know who is responsible for this formulation, but it seems to cover the idea well. Research is applied to unknown problems and situations with the objective of disclosing new truths, new facts, new knowledge. Furthermore, this definition rules out haphazard processes, by stating that research should be an organized effort. In other words, the research designed to explore the unknown must be orderly, must start from established premises, and must work toward some definite objective.

The scientific research which is of particular interest and concern to the engineering profession is, in this country, mainly undertaken in the science departments of the universities and in the engineering schools, and also in the industrial research laboratories. Let us for the purpose of this discussion designate the former as "academic research," and the latter as "industrial research." In discussing academic research, my comments particularly apply to the situation at Massachusetts Institute of Technology.

Research undertaken in an academic institution has a dual purpose: (1) to establish new knowledge, and hence to contribute to the progress of the art, and (2) to be of educational value.

The excellence of an academic institution is frequently and correctly judged by the results of its research, that is, by the new knowledge established therein and the contributions to the art made from it. Such contributions indicate that the institution is alive and progressive and that it has among its staff members men of sufficient stature to be leaders in their respective fields. Such institutions will command the respect of the public, will (in the case of private institutions) be in a preferred position to receive liberal endowments and funds for important investigatory work, and will draw advanced students from among the country's best university and college graduates.

It is only fair to say, I believe, that Technology is an institution in this category. The research work undertaken here has yielded many notable results, and many of its staff members have national reputations as authorities in their individual lines of work. A large number of important publications originate each year from the staffs of our many departments, and also from the majority of our doctorate as well as from some of our Master's candidates. As an illustration, let me say that during the academic year, 1935–36, a total of 24 books and 299 scientific and technical papers were published.

In regard to the educational value of research, of course the executor of any particular problem — staff member or student — will learn, and usually learn much, by the investigatory work he is undertaking. There is another and possibly even more important aspect of the educational value of research in an institution like this, however; namely, the value of research work in the aggregate as *an important factor in the general educational process.* By seeing research activity under way on a comprehensive scale—whether this be staff research or graduate-student theses, and even to a lesser extent undergraduate theses—by being (so to speak) surrounded by research, the student, even quite early in his undergraduate career, will appreciate that there still exist unsolved problems. We don't know everything yet. There are still a thousand and one things which it is worth while to investigate. The fact that research is in progress, handled enthusiastically by staff members and by students in the thesis stage, should whet the mental curiosity of the younger undergraduate, and, indeed, instill in him the spirit of inquiry. The stimulating effect of this investigatory work, we believe, will be felt by you and help you yourselves to acquire an urge to do independent investigation.

Your first real opportunity for this kind of endeavor will be in connection with your Bachelor's thesis, although you may earlier get the feeling of it, if you so desire, in some of your regular laboratory work, if you take advantage of the opportunities now offered in most departments to make some of these experiments comprehensive and of an investigatory nature and perchance along some line of your individual interest. It is naturally not expected that an undergraduate thesis will produce much of a contribution to the art. Its value primarily lies in the educational benefits which you yourselves will derive from it. In the graduate thesis this aspect changes. Thus, in a Master's thesis, a certain contribution, although small, would be expected. In a Doctor's thesis, on the other hand, which represents the investigation of an advanced problem, a very definite and quite material contribution is required.

It is my hope that you have gathered from the above that it is desirable and to the best educational advantage that teaching and research, so to speak, go hand in hand. This principle is, I believe, generally accepted at Technology, and is quite well established in many of its departments.

It is not my intention to discourse at great length on the question of industrial research. As already mentioned, this type of research is centered in the industrial research laboratories of which there is a large number in this country. The most notable ones are those attached to some of the larger corporations like the research laboratories of the General Electric Company, the Bell Telephone Laboratories, the General Motors Laboratories, the Aluminum Research Laboratories, the Du Pont Research Laboratories, the East-

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# Training vs. Education

## *Is the Engineer Trained Liberally Enough?*

BURTON P. FOWLER

TO one not technically trained, a prospective contributor's first glimpse of the TECH ENGINEERING NEWS is a bit bewildering. "Structural Aluminum" and "Propeller Stresses" are worse than the proverbial Greek to a mere headmaster who would not know a "torque variation" if he saw one, and whose own technical skill is limited to helping boys get ready to unravel such scientific mysteries in college. The teacher, in fact, prides himself that he deals with human material as opposed to the inanimate steel and stone of the engineer. A moment's reflection, however, reveals the fallacy of such a position. There is, of course, no differentiation between material problems and human problems. All problems are human. The scientist who studies the structural alloys of aluminum is only incidentally concerned with the properties of these alloys. Fundamentally he knows that human safety and service depend upon his skill.

It is important that the undergraduate engineer should never lose sight of this long view of his study. Otherwise he may gain the whole world and lose not only his own soul but that of his fellow men as well. Even pure science is dependent for its brand of purity upon freedom from specific commercial utility rather than from social usefulness since the very idea of knowledge implies the advancement of human progress.

The newer trends in education are in harmony with this philosophy that indicates the basic purpose of all higher education to be the preservation, transmission, and enrichment of a culture that is the product of research and human experience. The task of any college is to give its students the meaning and vitality of this purpose in their everyday lives, so that each will develop to the limit his potentialities and make his contribution toward the betterment of society.

If one may speak of the *old* education, its fault lay not in its materials, such as the classics, mathematics, grammar, and logic, but in the student's own lack of purpose and understanding. Most modern educators are agreed that the blind assimilation of the printed page, no matter in what language it is printed, has little bearing on the development of human powers. The student's own ideas are the ferment that leavens his reading and study. Thus *critical thinking*, the testing and application of what is read rather than memorization, becomes the goal of his study.

Human progress depends, however, upon much more than the superior wisdom of a "brain trust." Men may be great philosophers and scientists in the popular conception of those terms and still hinder rather than help human advancement. He may know everything and do nothing. In these days it is hard to think of a man as an educated person unless he is skilled in the art of working with others. He must know how to co-operate. It is not enough to build airplanes of the finest alloys, whose propellers will never fail; the fate of civilization may rest on whether the airplane is to become a servant of peace or an instrument of war. Do the men who design, build, and use airplanes envision a world smaller and more united because of improved methods of transportation or one in which they see greater possibilities of raining death and destruction on helpless cities in time of international conflict. It matters much to the future of America and the world which view young men take who are now undergraduates at Technology.

A few years ago civic and political conditions in a suburb of New York City became notoriously corrupt. Investigation showed that many of the leading citizens of this suburb were distinguished professors of economics and sociology in a nearby university. They were bookish experts who took not the slightest interest in the practical affairs of everyday life. They were men of thought rather than action. Dr. John Dewey expressed this idea clearly when he said that "a chief end of education is to see the defects in existing social arrangements and *to take an active part in bettering them.*"

The human element in engineering is even more complex than thinking critically and acting co-operatively. It also involves that field of intangibles which lie in the world of imagination. The scientist sees his San Francisco bridge, his Boulder Dam, his synthetic rubber as realities long before his first design or experimentation is begun.

College students are frequently criticised today for their lack of imagination. They believe, we are told, only what they see and greet the unseen with the familiar shrug of the shoulders. Poetry, painting, music, are all too frequently dismissed as highbrow and sissy because the aesthetic sensibilities which are the priceless inheritance of every human soul lie dormant in minds dulled by absorption with mere things. Physical comfort, the product of modern technology, is in danger of destroying our capacity for imagery, thus leaving us behind instead of ahead even of our ancestors, whose love of the beautiful was expressed in many details of their daily living. Too high a price may be paid for years of intensive study devoid of contact with the spiritual and aesthetic world. Great credit is due those deans of technical institutions who are seeking to broaden the training of engineers by courses that are concerned with the enrichment of human personality. An engineer must be a friend, a father, and a citizen as well as a technician if he is to live richly and contribute fully. Calculus, mechanics, and chemistry are but the tools of skilled labor; the spirit is nourished by literature, the arts, religion, and human relationships.

Basic to all education, moreover, is good health. A healthy body and a wholesome personality are the cornerstones essential to a beautiful and useful superstructure. A man may be an animated encyclopedia, but if he has a dyspeptic, crotchety nature, loaded with fears and emotional conflicts the world will pass him by. It may be argued that geniuses are neurotic, but so few neurotics are geniuses that most of us need to lay a foundation of the best possible physical and mental health in order to succeed. We live in a day when emotional disorders are alarmingly frequent. Mental hygienists tell us that about as many adolescents will find their way to sanitariums for mental disorders as will go to college. Therefore it is important that young people understand something of their psychological make-up and become familiar with the processes of adjustment by which each person may achieve emotional security. The modern college with its highly efficient personnel work is rendering a valuable service in this respect. The undergraduate should be as quick to avail himself of its facilities as he is to consult the college doctor.

Can the engineer be an educated as well as a trained person? He can if he wants to be, and if his college offers a reasonably liberal curriculum.

(*Continued on page 133*)

# Aviation Insurance

## *Engineering Is Important Even to an Actuary*

JEROME LEDERER

PUT yourself in the position of an insurance underwriter. You are about to sign your name to a policy which will insure the Squeedunk Flying Service against Fire, Windstorm, Theft, Passenger Liability, Public Liability and Property Damage. The airplane is of a well known, four place (one pilot, three passengers) make. It is valued at $10,000. The instruments and radio alone are probably worth $1500. In the event of injury to a spectator or to someone's property you agree to protect the legal liability of the Squeedunk Flying Service to the extent of $10,000 and pay the cost of the legal defense. You also agree to insure their legal liability to passengers at $20,000 per passenger seat. In short you are assuming, on behalf of your company, a potential fire loss of $10,000, a theft loss of $10,000 (but the instruments rather than the airplane are usually stolen), and a potential liability loss of $80,000.

In return for this protection your company will receive a premium of about $900 (Note: If the airplane were used for only private and pleasure flying the premium would be only about $550). Ninety thousand dollars worth of protection for $900. Complete losses, however, are rare. Nevertheless, they do occur.

The underwriter must also consider minor losses. For example, if the radio and a few instruments are stolen, or if the airplane should swerve into some other airplane (perhaps due to a faulty brake), or if a passenger should slip while getting out of the cabin, the loss in each of these cases would probably exceed the premium of $900.

You are an aviation insurance underwriter because you are presumably familiar with both insurance and aviation. But you need as much information as possible to rate and underwrite the risk intelligently; then after you have agreed to the insurance you will want to keep your losses down to a minimum. For these functions you turn to your engineering department. The engineer should be able to:

1. Present essential information for the determination and valuation of risks; and
2. Reduce losses.

In aviation insurance the duties of an aeronautical engineer are analogous to those of a doctor employed by life insurance companies. The doctor examines the prospect to give the life insurance underwriter an estimate of the risk. Then he tries to reduce losses by encouraging periodic examination and good health among the insured.

In a like manner the aviation insurance engineer concerns himself with the physical condition of the airplane, the construction and housekeeping of the hangar in which it is usually stored and the field from which it operates. In addition to this he has the more difficult problem of investigating the "health" of the organization which operates and maintains the airplane.

Going back to the Squeedunk Flying Service, the engineering department will ask for a thorough inspection of their airplane by a competent airplane mechanic familiar with that type of ship. In addition to reporting on the airplane, he may also submit a report on the condition of the hangar, the housekeeping and field management. In most cases the airplane operator welcomes this inspection because it acts as a check on his own maintenance and operating policies.

The airplane owner can usually correct any defect or faults which the inspector finds. In this respect the inspection differs from the life insurance examination. Criticisms by insurance companies' inspectors do not affect the rate in any way if the owner's attitude is co-operative, and it usually is. After all the underwriters are helping him as much as themselves.

The underwriters will know from the inspector's report:

1. The condition of the airplane: this affects the liability risks; the fire risk, and also the risk of accidental damage if "crash" insurance is carried.
2. The condition and management of the hangar: this affects the fire risk, theft risk (night watchman, doors locked, etc.) and windstorm risk (weakly constructed hangars usually are destroyed by windstorm, collapsing on the airplanes inside).

This is only the first step. The equipment may be in excellent condition but the ability of the owners to operate it safely must also be evaluated. What are the operating policies? Does the Squeedunk Flying Service indulge in passenger hopping from small fields? Are the fuel tanks aways kept adequately full or is a small fuel supply carried so that the payload can be larger? Do they overload? At what periods are engines overhauled? How often are they checked? How competent are the maintenance foreman and his crew? Does the pilot employ a conservative technique? Are his employers likely to force him to take chances? Is the organization definite and businesslike, or ambiguous and sloppy? These considerations relate to personnel, but they are closely associated with the engineer because they can be completely evaluated only by familiarity with good practice in the operation and maintenance of airplanes.

The Squeedunk Flying Service has been chosen as an example. However, no one instance can show the immense variety of problems and the technical ramification which face the aviation insurance engineer. If the aviation business was as static as say the automobile business, it would be possible to write this article categorically. The constant improvements, new developments, changes in technique and tremendous difference in type of aircraft and operations makes this impossible. Going from the particular to the general, however, the aviation insurance engineer considers the Squeedunk Flying Service as only one of numerous combinations.

To give an idea, any one of the following types of operations:

*Usually referred to as Itinerant Operations*

1. Airline operation
2. Charter services—corresponding to automobile taxi service
3. Industrial aid—crop dusting, survey, advertising, etc.
4. Private and pleasure flying
5. Racing and airmeets
6. Experimental and test flights
7. Stunt flights
8. Airport operation

except the last, airport operation, which usually involves only liability, may be combined with any or all of the following types of insurance.

Insurance which pertains to the airplane itself, such as Fire or Crash is called *Hull* Insurance and is carried by the *Fire* Insurance Companies. Insurance which protects the owner of the airplane against damage to someone else's property or injury to someone else is called *Liability* Insurance and is

carried by the *Casualty* Companies.

The following is a brief description of the more common forms of aviation insurance. These coverages of course are subject to the terms and conditions of the policies.

## AIRCRAFT HULL POLICY

*Fire Coverage*

The Fire coverage also includes the risks of Explosion, Lightning and Transportation.

FIRE UNDER ALL CIRCUMSTANCES. This covers damage by fire from all causes. It includes fires in hangars, on the ground, in the air and fires following crash.

FIRE UNDER ALL CIRCUMSTANCES EXCLUDING FIRE FOLLOWING CRASH. This is the most commonly accepted form of fire coverage and covers damage by fire from any cause, in hangars, on the ground or in the air. The one exclusion under this coverage (fire following crash) is made a part of Crash coverage. This is to the best interests of the Assured as it eliminates the necessity, after a loss, of trying to determine the amount of damage caused by the crash and that caused by the subsequent fire.

FIRE GROUND ONLY INCLUDING RUNNING OF ENGINES. This covers the important hangar fire risks, fires caused by backfiring while starting or running engines, fires due to short circuits or occurring while welding is being done, etc.

FIRE GROUND ONLY EXCLUDING RUNNING OF ENGINES. This covers hangar fire risks, fires caused by short circuits in the planes' electrical equipment or fires occurring while welding or other work is being done. This coverage is particularly acceptable when aircraft is in storage.

*Crash Insurance*

This covers damage to the machine arising out of flight and that portion of the taxiing risk not covered under LAND DAMAGE. The maintenance and flying operation of the machine has a direct and important bearing on the hazards covered.

*Land Damage*

This covers damage which may be caused to the machine while not in motion, also damage caused by being struck by other aircraft, hail, vehicles, etc., and while taxiing except taxiing after flight.

*Windstorm*

This form of protection covers the usual windstorm risk which, in the case of aircraft, is much greater than that on fixed property, due to the fact that aircraft are of light weight construction and purposely designed to obtain the maximum lift from the slightest air current.

*Mooring*

This coverage is applicable to aircraft which use the water for landing or take-off. While being moored, an aircraft is exposed to the hazards of being run into by other craft using the water, or sinking from a variety of causes. There is also danger from sudden squalls with resulting high waves, which may tear the machine from its moorings and destroy it.

*Theft*

This coverage includes damage caused to the machine if stolen and thereafter found wrecked. It also indemnifies for accessories and valuable instruments which may be pilfered. If damage is done to the aircraft while thieves are removing instruments or parts, this damage is covered under this section of the Policy.

## AIRCRAFT LIABILITY POLICY

*Public Liability*

This covers loss arising out of the Insured's legal liability for personal injuries fatal or otherwise to the public, *excluding passengers*, caused by the ownership, maintenance or use of the aircraft. Personal injuries to members of the public caused by contact with whirling propellers are frequent and usually result in claims for heavy damages. There is also the hazard of a catastrophe loss if an airplane is forced to land in a built-up area or one crowded with spectators, or if the airplane should collide with another one carrying passengers.

*Passenger Liability*

This covers loss arising out of the Insured's legal liability for bodily injuries or death to passengers while in, entering, or leaving the aircraft. As in the case of Crash Insurance the maintenance and flying operation of the aircraft has a direct and most important bearing on the hazards covered.

*Property Damage*

This covers loss from claims or suits arising out of damage to property of others, excluding property of others carried on the aircraft, caused by the ownership, maintenance or use of the aircraft. The possibility of losses under this heading is the same as under Public Liability.

In addition to the above types of coverage which only apply to the aircraft and its operation and which are combined in one or two policies, the following separate policies can also be issued:

*Personal Accident*

Providing stated benefits for death or injury to Pilots, Co-pilots, or Passengers.

*Workmen's Compensation*

Covering the liability of an Employer to his Pilot or Mechanics under the Workmen's Compensation Laws.

*Airport Liability*

Giving airport owners or lessees protection against their legal liability for accidents at airports.

Returning again from the general to the particular, one of the most interesting assignments involves the survey of airline operations. In airline surveys, the aviation insurance engineer divides the problem into two great parts: Physical and Personnel.

Under Physical he considers:

1. Flying equipment condition
2. Adequacy of equipment and spares
3. Inventory system
4. Communication system
5. Weather forecasting and reporting
6. Maintenance and servicing procedures
7. Condition and adequacy of airports
8. Terrain and aids to navigation
9. Weather and climate
10. Type of flying
11. Nature of cargoes
12. Handling of passengers and cargo
13. Schedules
14. Operation and handling of flying equipment
15. Operation handling of ground equipment

Analysis of the Personnel problem is difficult to classify. The break-down varies with the nature of the operations, the most influential factors being whether passenger and freight are carried, whether day or night flying is practiced, whether good or bad weather conditions are prevalent, whether good or bad terrain is prevalent, whether competition is strong or weak, whether heavy or tight schedules are demanded. Generally speaking, the outstanding qualities to look for are:

1. Background and operating experience of key men in organization
2. Discipline and esprit de corp of the organization
3. Experience and ability of pilots and their attitude towards safety
4. The organization plan and success with which it is fulfilled
5. Ability, alertness and sense of responsibility of all personnel
6. Attitude of public towards the airline

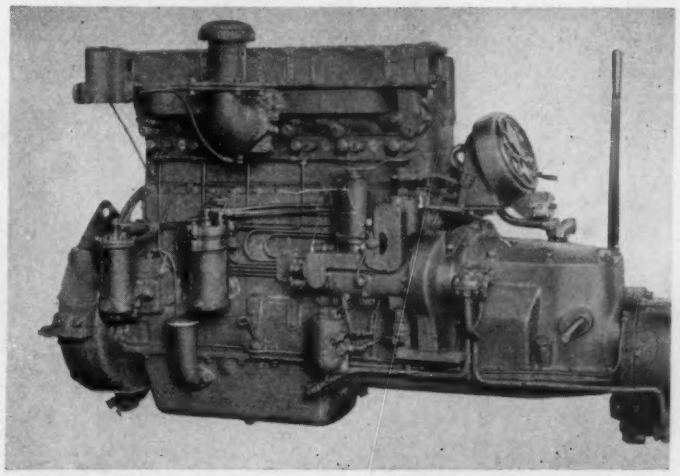
(*Continued on page 136*)

# The Diesel Engine

## *It Is More Reliable, More Economical than the Gasoline Engine*

NORMAN L. LASCHEVER

ABOUT a quarter of a century ago there existed a fairly economical cycle, of which the horse, then a commonplace animal rather than a comparative rarity as today, was the basis. He was a beast of burden and a method of transportation. He plowed the farmer's fields, and furnished the fertilizer thereof. In return for these services, the horse was fed and housed, which was not costly to do. He worked hard and long all his life, was not too expensive in his upkeep, provided for his own replacement, and when he grew too old was sold to the glue factory, or if the master were a little more kind-hearted, was allowed to live out his normal life, existing now on the bounty of his master. Perhaps the horse had nothing to recommend him hygienically; yet he was a simple expedient. But now, the advent of the gasoline engine, and its result, the automobile, has thrown a myriad of complexities into the life of mankind. The automobile with all its virtues and vices has yet one disagreeable feature, its running expense, the expense of that precious fluid, gasoline. It seems, however, as if nature has a way of providing for sudden eventualities, because as far back as 1892 efforts had been started that were to have great bearing on the lessening of the cost of running the internal-combustion engine. For it was then that Dr. Rudolph Diesel, a German scientist, proposed and applied the theory that bears his name, the theory of the Diesel engine.



*—Courtesy Diesel Power.*

Before going directly into the theory of the Diesel engine, let us see what preceded and perhaps inspired it. The *middle-age* scientists had demonstrated that work could be done by internal-combustion engines. Later, in 1680, an experimenter named Huyghens built an engine, crude of course as compared to our modern versions, utilizing the principle of the internal-combustion engine. During the next two hundred years very little work was accomplished on this principle, however. The first engines failed primarily because of their unreliability, which can be traced largely to a lack of proper materials, a drawback modern metallurgists and chemists have overcome. The first commercial type was the Lenoir engine, using a two-stroke cycle, and having a thermal efficiency of less than four per cent. About 1860 Beau De Rochas suggested a four-cycle engine that was to burn gas. He never built an engine of this type, however, although Otto's experiments with his own fire-piston engine led him to try Beau De Rochas' theory. The result was the famous Otto Silent Engine, one with a single cylinder, and of the horizontal type. It had a sliding-plate admission valve, and a poppet exhaust valve. This engine was first shown at the Paris Exposition in 1872. All the early predecessors of the modern gasoline engine operated on the constant volume principle, instead of the so-called "Diesel Cycle" of constant pressure.

The first idea like that of Diesel was shown by George Brayton of Philadelphia, who patented an engine in 1872 burning a gas-air mixture at constant pressure. It was, however, far from the Diesel principle, although it was the most efficient engine of the time. The Hornsby-Ackroyd engine used a liquid instead of a gaseous fuel, but great difficulty was experienced in the proper vaporization of the fuel. This was accomplished, though, by putting previously-heated fuel into a hot chamber in the cylinder head. After initial heating, the fuel was vaporized by the heat of the previous combustion. As the air in the cylinder was already compressed, the projection of the fuel on the walls caused a turbulence, and the mixture ignited on touching the hot interior surface. This is the principle of the Semi-Diesel engine.

Gasoline engines were already in use, when, in 1892 Dr. Rudolph Diesel after careful calculations proposed an hypothetical engine that was to use finely-divided coal as a fuel. This fuel was to be ignited, not by a spark or flame, but by the heat caused by compressed air. The injection of the fuel would take place during the stroke following the compression stroke, and at ten per cent of the crank cycle. As first proposed, the engine embodied a type of controlled combustion, and enough heat was to be produced to equal the work done by the advancing piston. According to this theory the gases were to expand adiabatically; that is, neither absorbing nor giving heat except in work done. Two German firms, the M. A. N. and Krupp firms, helped Dr. Diesel to develop his patents. It is said that his first engine blew up because of piston seizure. Diesel's next engine was somewhat modified, and he finally substituted combustion at constant pressure for combustion at constant temperature, as the latter type was seen to be infeasible. Also, crude oil came into use as the fuel. The first Diesel engine in the United States was built by Adolphus Busch in St. Louis, while 1902 witnessed the first Diesel central power plant in use here. By 1915, however, there were in service enough engines to total 50,000 horse power. So much for the history. Before going on with the detail of more Diesels, let's see what distinguishes their principle from those similarly divided in other internal-combustion engines.

The internal-combustion engine can be divided into six different groups, all depending on the fuel used. The following

table gives these groups.

1. Gas engines, using coal gas, producer or blast-furnace gas.
2. Light-oil engines, using gasoline, benzol.
3. Medium-oil engines, using paraffin.
4. Heavy-oil, low-compression engines, using shale, petroleum, and tar-oil distillates.
5. Heavy-oil Diesel engines, using petroleum residual oil, and tar-oil distillates.
6. Heavy-oil, high-compression engines, using the same fuels as the Diesel engine.

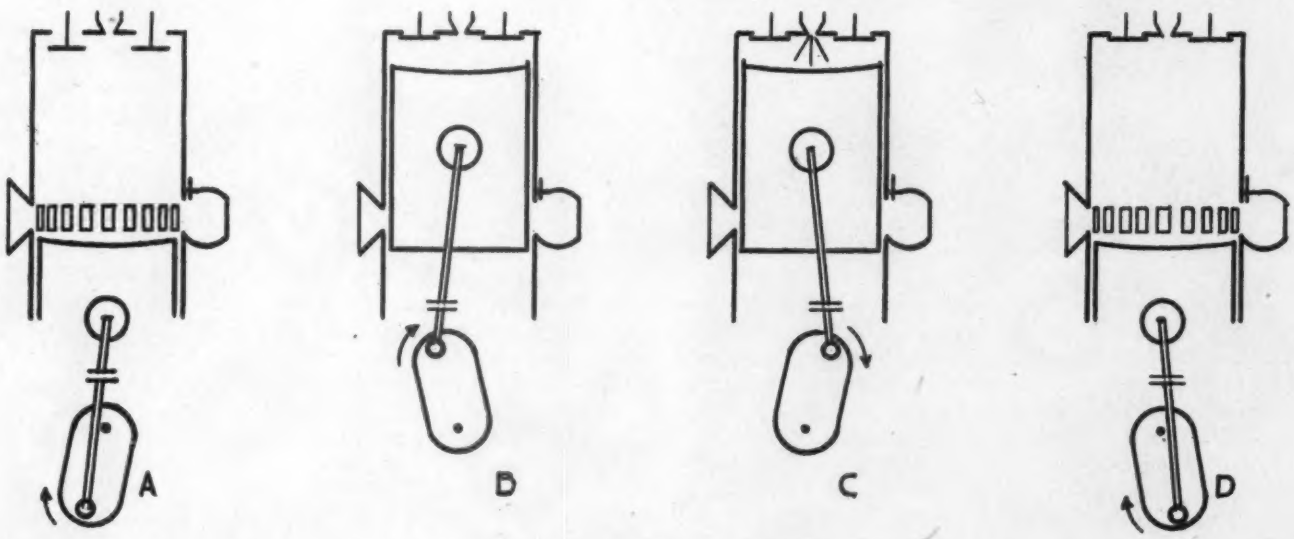
These different types have two main features in common. First, the arrangement of the principal working parts, such as the cylinder, pistons, connecting rod, and crankshaft is the same, or practically so; and second, all can, and do work on either the two- or four-cycle principle.

The differences of engines result from the different fuels used, and the arrangements necessary to mix the gas with air in the correct proportions and then ignite this mixture. The fuel for the light-oil engine is a liquid, whose essential property is that it may be easily vaporized at ordinary temperatures. This type of fuel, when mixed with air in the correct proportions, is also ignited by a spark. The medium-oil engine fundamentally is like the light-oil engine, except that its fuel, a liquid such as paraffin, must be artificially heated for vaporization. Fuel, and air for combustion, are passed through a specially-heated chamber where sufficient heat is given for a correct mixture. Oil used in the heavy-oil, low-compression engine is vaporized in a chamber attached to the cylinder, a part of the compression space. Heat from the successive explosions keeps the walls of the chamber, called a "hot-box," at a high temperature, and the oil, injected at correct moments every cycle, is vaporized by contact with the walls and by the heat of compression. The hot-bulb has to be artificially heated before the engine is started. The heavy-oil, low-compression engine allows the use of a heavy fuel that is harder to burn than paraffin. The fuel is injected directly into the cylinders, and is burned only by the heat of compression, a gradual combustion occurring as the fuel enters. In the first three types, the fuel explodes in a type of combustion known as "combustion at constant volume;" that is, in a closed chamber. The heavy-oil, high-compression engine is a modern development combining the hot-bulb of the low-compression engine and a compression approaching that of the Diesel. The compression is high enough to make pre-heating of the hot-bulb unnecessary. A dual-combustion occurs in this engine, part of the oil burning at constant volume, and part at constant pressure. A table below gives at a glance the salient features of the six types of engines that have been discussed.

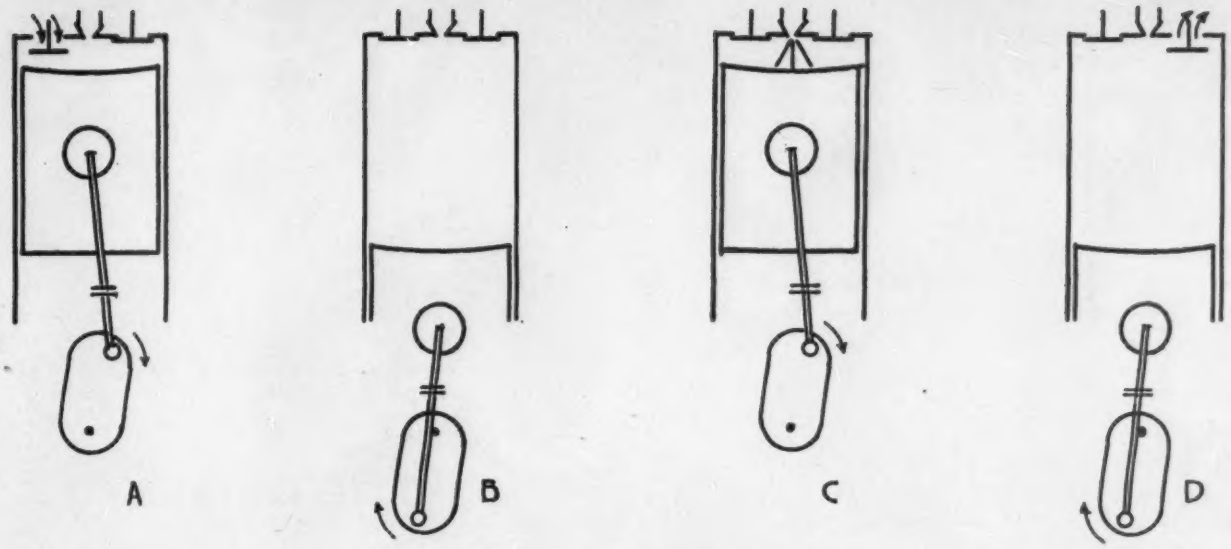
The true Diesel engine is one whose cycle includes the following three principles: (1) Intake and compression of pure air only; (2) Compression to a high degree to vaporize and ignite the fuel, as admitted, only by the heat of compression; (3) Fuel injection timed so that combustion starts at the point of maximum compression, and continues at such a rate as to maintain fairly constant pressure during combustion. In the last of these features, Diesel departed from his original patent specification of combustion at constant temperature.

As before stated, the Diesel engine can operate on either the two- or four-cycle principle. Let us first discuss the features of the four-cycle engine. Referring to the diagram below, the first stroke is seen at A, where the piston is moving downward and pure air is coming in through the inlet valve. All other openings are closed. The second stroke is at B; the piston is moving up compressing the air so that a pressure of 480 pounds per square inch is reached at the end of the stroke. At this time all valves are closed. The third stroke, that of work, is shown at C, where one sees the piston moving downward and fuel being admitted through the valve in the middle of the cylinder head. During the first part of this stroke of combustion and expansion, the fuel is admitted at about 34 degrees of the crank cycle, and during the second part the gases expand behind the moving piston. The fourth stroke, shown at D, is the exhaust stroke, during which the piston comes up forcing the burnt gases out through the exhaust valve.

We now come to the two-cycle Diesel engine, in which the air enters through valves in the head, and the exhaust gases escape through a series of ports around the circumference of the cylinder. The ports are uncovered by the piston at the bottom of its stroke. Such an engine is known as a valve-scavenging type. Following the diagram below, one sees the scavenging stroke at A, during which the piston is at the beginning of its upward stroke. The inlet valves in the head are open as are the exhaust ports. Fresh air is pouring in, while the exhaust gases are flowing out. The pressure of the air is slightly above atmospheric pressure at this time. At B the piston is further up, and the exhaust ports are closed, as are also the inlet ports. This is a stroke of compression. The piston is partly down at C, which depicts the working stroke, during which the fuel is injected and burned, and the gases are expanding. The piston has just uncovered the exhaust ports at D, and the gases are streaming out into the atmosphere, because they are still considerably compressed. The pressure is soon down to that of the atmosphere, however. After the piston uncovers a certain depth of exhaust ports, the inlet valves reopen and fresh air comes in, scavenging most of the burned gases, continuing until the exhausts are




*Schematic diagram of a two-cycle engine.*




*Schematic diagram of a four-cycle engine.*

closed again. Fresh scavenging air comes from a special pump that is generally built with and run by the engine. Let it be noted that in the exhaust stroke the gases are expelled at practically atmospheric pressure, but at a temperature of 750 degrees F. This lost heat comprises about 25 per cent of the total heat value, and constitutes one of the principal sources of inefficiency.

Fuel injection is naturally a major problem in any type of internal-combustion engine, and is especially so with the Diesel. The essential features of injection may be summed up as follows: (1) Injection must begin so that combustion starts at the point of maximum compression. (2) It must be continued at the correct rate in order to keep a fairly constant pressure. (3) Injection should atomize or break up the oil to facilitate vaporization. (4) Oil must be distributed effectively to all parts of the combustion space. (5) The correct quantity of oil must be delivered in each working stroke. Two systems, "air-injection" and "solid-injection," are now in common use. The oil is blown by compressed air through a small valve, in air-injection, and enters the cylinder thoroughly mixed. Mechanical pressure forces the oil through a valve, in the solid system, and the oil enters as a finely-divided liquid. Air-injection was first adopted commercially, and is the standard system, being more efficient than solid-injection. Its disadvantage is that the entering air is cold, and has a slight cooling effect.

Starting is one of the prime difficulties of the Diesel engine, but is gradually being overcome by more efficient and feasible methods. Compressed air is used to start the engine by being forced into the cylinder. In the cylinder head is a valve operated by a lever and cam, driven by and timed with the crankshaft. During starting, the valve is open through fifty per cent of the working stroke, and admits highly compressed air that acts on the pistons, setting the motor in motion. A simple mechanism is used to insure that the fuel valve is not open while starting. A valve lever in the engagement lever throws the starting valve out of action and the fuel valve into action as soon as starting is convenient. Then the fuel reservoir is shut off and the receiver recharged to be ready for the next start.

So far, this discussion has been fairly technical and theoretical, giving no uses of the Diesel engine. Let us discuss a few facts about marine and aeronautical requirements. As the load factor in these cases is usually quite high, engines are required to develop a greater percentage of their rated power during a larger part of their operating time, and thus are put under greater strain. Diesel engines are certainly safer for boats and airplanes, because of the preclusion of a fire hazard. Cruising range is increased because of reduced fuel consumption, while a Diesel-equipped plane has a 25 per cent greater cruising range at one-fifth the cost per mile for fuel, than has a plane with a gasoline engine. Detonation, of course, is very dangerous in airplane engines, which must be lightly built, for intense strains are transmitted to the frame. Air-cooled Diesel engines present fewer cooling problems than do air-cooled gasoline engines, while the high cylinder-head temperatures that cause pre-ignition and detonation in a gasoline engine present no serious handicaps to the Diesel engine.

Exhaust-valve conditions are more favorable in the Diesel than in the gasoline engine, because of the high expansion ratio. Very little flame can be seen from the exhaust ports of a Diesel engine. In fact, it was possible for a Stinson-Detroiter with a Diesel to be flown without exhaust valves or manifolds. A Diesel aircraft will operate in any position as there is no carburetor that depends on gravity to function correctly. Diesels are not affected by rain, having no high-tension electric circuits. For the same reason, Diesel users do not encounter radio interference, to prevent which the gasoline engine must be shielded. One often hears rumors of secret rays having been invented capable of putting an airplane engine out of operation by impairing the functioning of the ignition system. It is apparent that such rays, if they exist, are perfectly futile against a Diesel engine. Perhaps the major objection against the use of Diesels in aircraft is the heaviness of the engines. However, the Diesel is 33.7 per cent efficient as compared to 22.9 per cent for the gasoline engine, or almost ten per cent more. This increase of efficiency allows the use of less fuel in a Diesel plane, thus making up for some of the increased weight. Also, the initial cost of the Diesel is higher than that of the gasoline engine. But crude oil is much cheaper than gasoline; therefor making up for increased initial cost by lower running costs.

The application of Diesel engines to locomotives has several interesting aspects. Several years ago the manufacturers of several kinds of industrial locomotives started to use high-speed Diesels. Because of their high torque at low speeds, these engines possess much ability to haul loads over long, steep grades, ability which is greater than that of a gasoline engine of the same size and horse power. The increase is still greater over engines of other types. In one test made on a ten-mile track connecting the Gainesville and Northwestern Railroad with stone quarries at Chestatee, Georgia, two thirty-ton Diesel locomotives replaced one eighty-ton steam locomotive. The combined locomotives hauled one more car than the eighty-ton locomotive, and showed savings in fuel and repairs.

Perhaps the most interesting question connected with Diesel engines is whether they will ever enjoy widespread use

*(Continued on page 134)*

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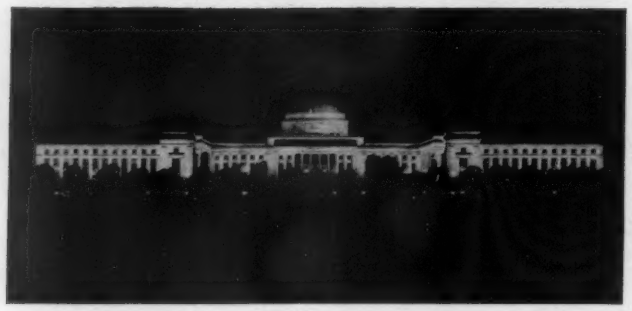


# EDITORIALS

## *SCIENTISTS AND THE WORLD*

IN the popular mind, the scientist is classed as a strange variation of the human species—a man who devotes almost every waking hour to the solution of special problems in some highly restricted field. Although that picture is oftentimes distorted, the general impression is not far from the truth. The scientist lives as if in a sheltered cave, unmindful of the storm raging beyond the entrance. When some word of the tumultous outside world does penetrate his isolation, he shrugs his shoulders and goes on working.

Organized labor is on the march, the scientist hears. Millions of workers are demanding collective bargaining, a greater voice in the affairs of industry, better living and working conditions. Some industrialists have granted the unionists' first demands, he is told, but others stack their plants with arms and munitions, and prepare for large-scale industrial warfare despite the efforts of legislators to prevent ruinous strife between Capital and Labor. "But what effect can these things have upon my X-ray investigation of molecular structure?" the scientist asks. Since he discerns no possible connection between modern social perplexities and his special problem, he disregards the former as beyond the scope of his attention.

Perhaps the scientist is told of "the plight of the middle class." Ever-rising taxes for social security, unemployment insurance, and work relief, together with higher and higher wage levels, are destroying the small margin of profit upon which the "little man" depends for his very existence. If the earnings of the small business man decline to a level not far above that of his employees' salaries, he will be forced to close his doors and seek employment himself. In that event, the middle class as it is known today would have disappeared. But the scientist is unconcerned. "How can the welfare of the middle class possibly aid or hinder my research into carbonyls?" he questions. This being his criterion, the middle class obviously must look elsewhere for its champions.

To war and the threat of war the scientist is likewise deaf. Brother slaughters brother in Spain, each declaring with his dying breath that the faction for which he fought will bring the only "true" civilization to his country. In China, butchery continues apace. Hardly a day passes without the cryptic news dispatch . . . "both sides suffered heavy losses." The world passes from crisis to crisis, each time drawing nearer to Armageddon, yet the scientist remains aloof, disinterested, as if it were all a million miles away. The civilization hastening toward destruction is the civilization which the men of science, for the most part, have labored to bring forth. Yet, not a hand is raised from their midst, not a voice of theirs speaks out to question.

Seventy-five years ago, perhaps, criticism of the social inaction of the scientist could have been answered quite easily. He could have claimed that he must devote all his time to his work, that the solution of social and economic problems was properly the business of others. Today, however, that defense is not only inadequate, but totally unrealistic. Those "others" have failed dismally. In the past seventy-five years the applied sciences have progressed further than in all the centuries preceeding, yet the social sciences of government and human relations have not merely stood still; in some parts of the world they have retrogressed. In this year of 1937, international and civil disputes are still settled by mass murder. The ideals of the Declaration of Independence, set forth more than a century and a half ago, are today denounced as the "folly of democracy," and forthwith trampled under foot by self-appointed demi-gods. Even in peculiarly blessed America, where at least a degree of political freedom still exists, millions live in squalor, eat only of the poorest, dress only in the shabbiest. Yet even these conditions are superior to the lot of other millions abroad. The leaders are perplexed. Their prescriptions for one social disease only render the patient more susceptible to another more deadly. The principles of logical reasoning and intelligent planning which are the very foundation of the physical sciences have been completely ignored. The results could be nothing other than what they are—chaos, confusion, discontent, misery.

What is the good of new theories, new discoveries, new triumphs in the laboratories of the world, when civilization is in such imminent danger of annihilation? Is it not the height of folly to erect a second story while fire rages on the ground floor? If the scientist wishes to preserve the civilization which he and his predecessors have created, he must bring his trained mind to bear upon the problems of today. The world must be informed that the scientist will be content no longer to watch others control the products of his genius and his effort to their own selfish advantage. Once the chemist, the physicist, the biologist, and the engineer have asserted themselves, their influence as a social force will be incalculable. They are the mental driving wheels of modern mechanistic society. What a great voice they could have, therefore, in determining the elements of that society! The scientist has only to sacrifice some of his individualism, and join forces with his fellow scientists to achieve what, at present, seems improbable. Indeed, there will shortly be no alternative, for let the scientist remain isolated and, midst revolution and war, both he and civilization will be swept away in a tornado of high explosives.

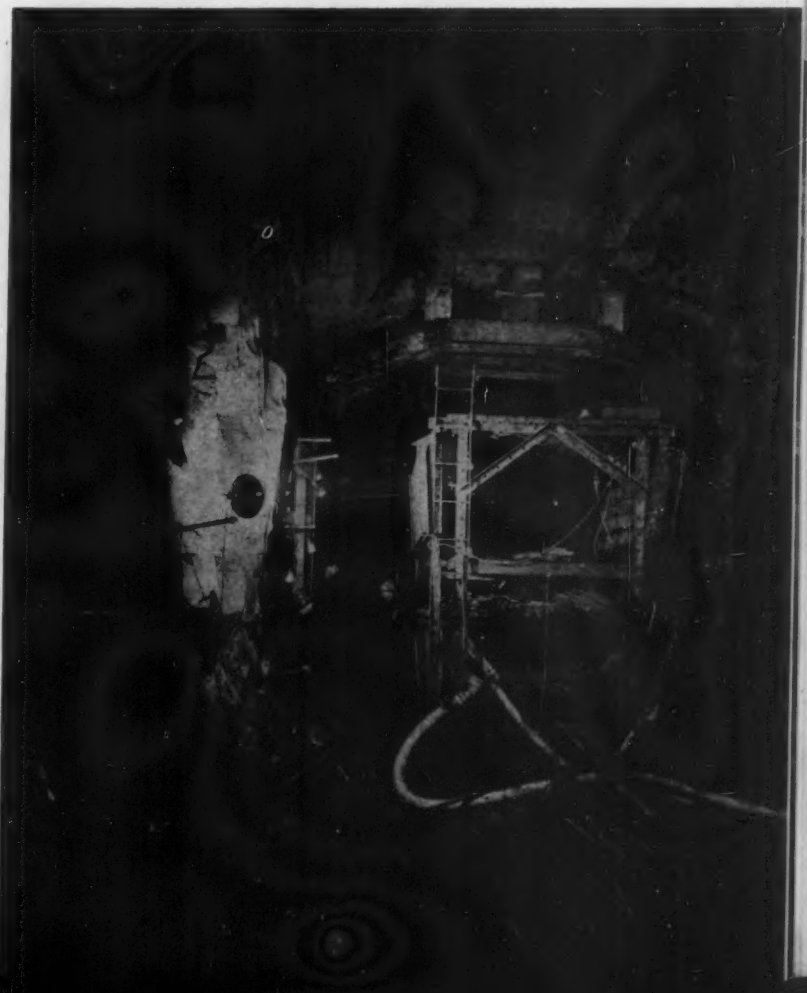
## *FIGHT SYPHILIS*

AT long last, the subject of venereal disease has begun to emerge from the darkness and ignorance of an almost medieval secrecy. Determined to end the sorrow of syphilis, U. S. Surgeon General Thomas Parran has opened war upon the dreaded curse, enlisting the aid of Federal, State, and city health bureaus, physicians all over the nation, and most important — the general public. Through the process of education, Dr. Parran and his associates are endeavoring to destroy the conception that venereal affliction is a public disgrace, to be shielded at all costs. Numerous pamphlets and magazine articles have appeared, hundreds of talks have been delivered, all in a great effort to induce every man and woman to undergo the Wasserman test for syphilis, and, if necessary, the treatment which follows.

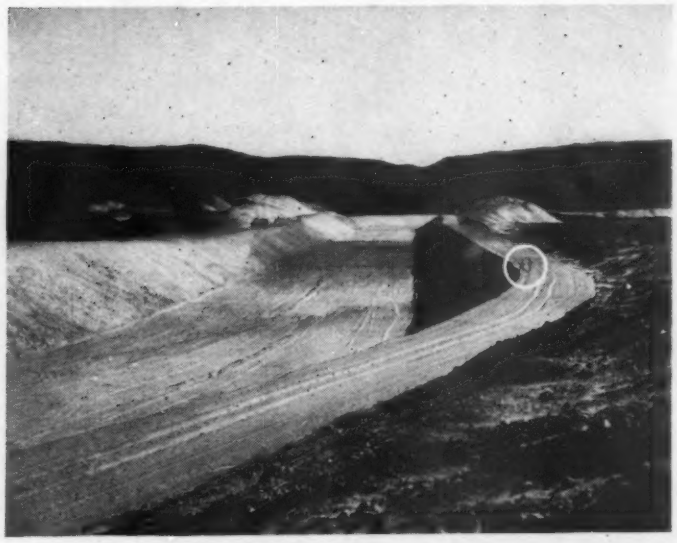
The results of the campaign have already been substantial. It was possible for Dr. Parran to report recently that thousands of physicians have received requests from their patients for the Wasserman test. Especially encouraging was the news from Chicago, where over one million ballots were distributed to ascertain whether or not Chicagoans were willing to submit themselves to the Kahn test for syphilis, at no personal cost. Of the first 100,000 ballots received, more than 96 per cent were checked in the affirmative. Although there are many old prejudices to overcome, and many months of medical work ahead, early triumphs have indicated that the toll of human life and happiness attributed to syphilis may soon be materially reduced. The thousands of innocent babies who would have been born dead or horribly disfigured may yet have that opportunity to live a normal life which is their birthright. Perhaps soon it may no longer be necessary for a man and his wife to go unhappily childless because of the ravages of syphilis. Paresis, neurotic conditions, and a host of other mental diseases will appear less frequently when one of their most important causes is removed. Medical science lacks no methods of treatment, certainly. Salvarsan has been known since the early years of the century, and, recently, other discoveries have supplemented the drug or even surpassed it in effectiveness. That syphilis has not been eliminated in the past, therefore, is the fault of the general public. Whether or not it will be eliminated in the future is also dependent upon that public.

It is the duty of the individual to enlist immediately in the fight against the plague of syphilis, and then to persuade those around him to follow his example. However little each one of us can accomplish, the sum of all our efforts will be enough to rid society of a disease that should have been stamped out several years ago. We at Technology should request that the Wasserman test be made an essential part of every medical examination in Homberg Infirmary. If a sufficient number of letters and other representations are received, the medical authorities will no doubt make provision for it. Let this effort be our contribution to a great cause, to the welfare of our communities, indeed, to our own well-being and that of our children.

*(Continued on page 134)*



# ENGINEERING DIGEST



## PRESS INNOVATIONS

FOR the shaping of "Turret Tops" Fisher Body has acquired three new heavy presses, each able to accomodate dies 180 by 100 inches. By locating the driving mechanisms below the factory floor, two major advantages are gained—first, the machinery is more easily installed and accessible; second, the quality of the stampings is improved, because vibration is practically eliminated as a result of lowering the center of gravity beneath the die and of the presses' perfect symmetry above the floor. Danger of disastrous overloads is lessened by precision-preloading, an operation which consists of hydraulically stressing all the tie rods simultaneously and equally to a predetermined amount. When the load is greater than this predetermined amount, the rods behave as springs and elongate, so that no critical stresses are developed in any of the press elements.

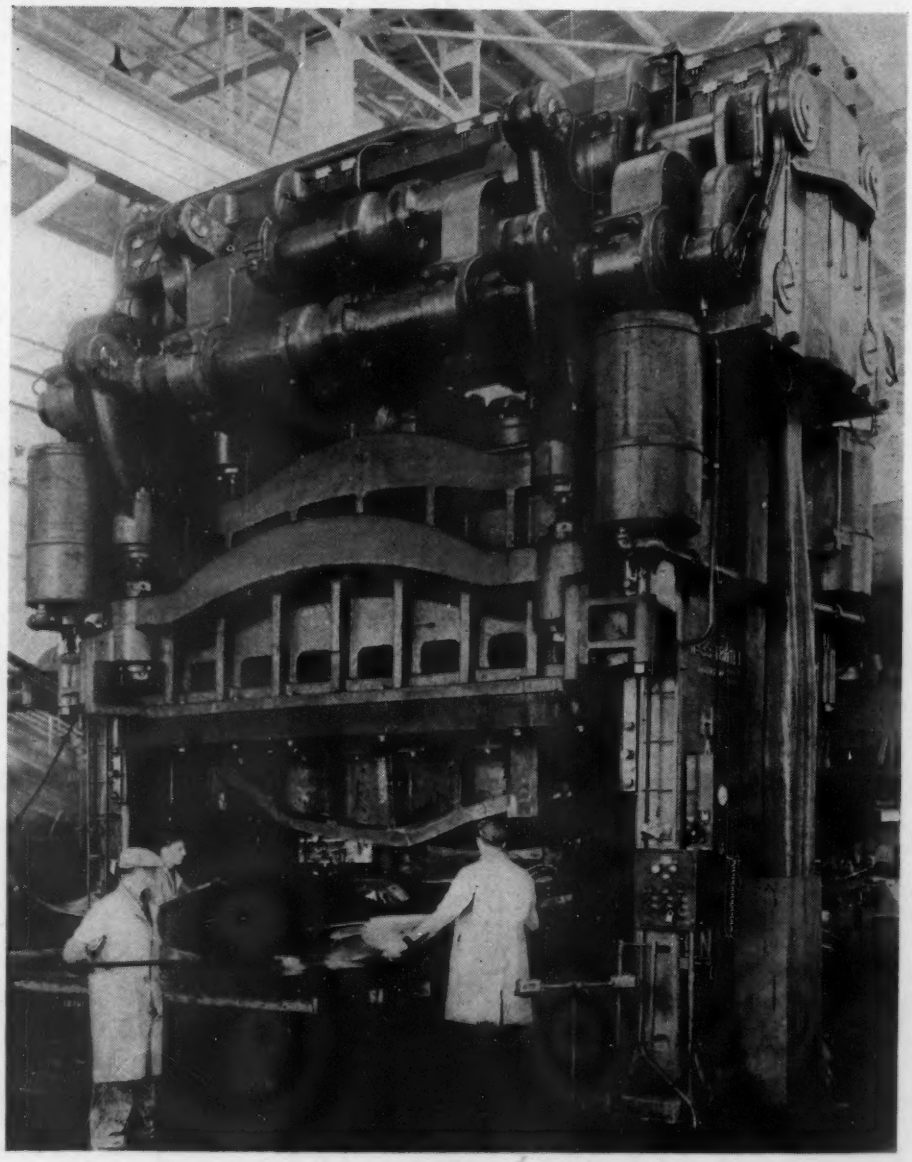
—*The Iron Age.*

## IRRIGATION CANAL

SO inadequate for the irrigation of southeastern California's Imperial Valley is the Imperial Canal that the United States Bureau of Reclamation is now constructing the All-American Canal, a larger, improved waterway leading to the Imperial Valley. The new canal will insure a sufficient water supply to the Valley, and will also make possible the cultivation of additional acreage.

The intake of the canal now being built is about fifteen miles upstream from Yuma, Arizona, on the Colorado River; it is capable of receiving 15,000 cubic feet of water every second. The flow can be maintained because of the regulatory facilities at Boulder Dam. At the intake is located the Imperial Dam, a concrete structure so placed that it will divert the water from the river into the canal. The water next passes through an immense plant where seventy per cent, from 50,000 to 70,000 tons daily, is removed to prevent its clogging ditches and damaging crops. Running to the westward toward the Valley, the canal encounters some sandhills. Here, measures that have been taken to prevent sand from blowing into the canal are growing vegetation, oiling the sand, and covering the sand with heavier material. Drops along the canal provide for the future installation of hydro-electric plants.

—*Scientific American.*



## CONCRETE SHELL ROOF

ONLY last year the principle of crowning or curving plates to produce rigidity, as in corrugated iron, automobile fenders, and paper dishes, was used in the Sports Arena at Hershey, Pennsylvania. Here, the shell is a thin, properly reinforced concrete plate, which carries over a distance of 222 feet without intermediate supports. The freedom of obstructions inside the hall gives a monumental appearance, fireproofness, and permanence. Although the design is quite intricate, the construction offers no unusual problems.

— *Scientific American*

## TAILORED RADIO WAVES

A DOUBLE watermelon, a fan, a shamrock, and an airplane propeller are only a few of the sixty odd field patterns over which an engineer several years ago discovered that radio waves can be directed by two antenna towers. Before that time the waves which radio stations sent out traveled in ever-expanding circles, so that much of their energy was wasted on sparsely populated areas. Often stations could not easily reach nearby cities with their undirected signals because of restricted power. When methods of directing the waves were discovered, a small station in Florida tried out the scheme, and found that the field pattern of the waves was of the shape predicted. Today there are thirty-nine stations on the air having directive antennas, and more are being built.

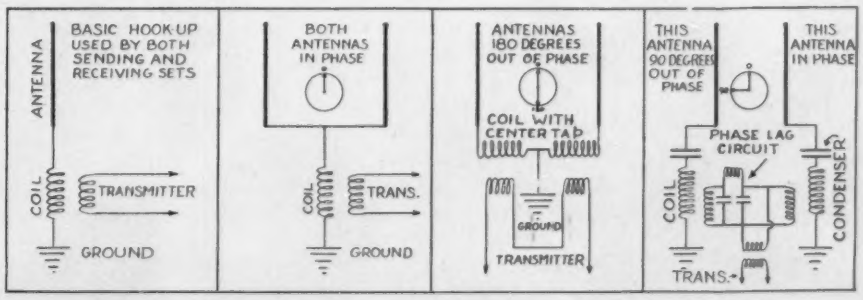
The principle of the directive antenna is simple and quite old: Hertz discovered that a wire parallel to the antenna served as a reflector. The new antennas consist only of thin steel towers rising to great heights. The tower itself is the aerial, so no wires at all are used. What actually happens is that the energy is directed toward a pre-determined destination and suppressed elsewhere. The basic radio circuit, shown in the diagram, is the same as is used in almost every radio set in the world—an antenna, a coil of wire wound on a form, a ground connection, and either a transmitter or receiver coupled to the coil. A station using this antenna system would radiate signals uniformly in all directions. When two antennas are used, as in the second diagram, the result is an extended or directed pattern. A station located in Philadelphia, for example, could cover nearly the whole Atlantic Coast, and be completely inaudible on the ocean or west of the mountains. Both antennas must be exactly alike, and the lead-in wires must be the same length down to an inch. The distance between the antennas governs the length of the pattern.

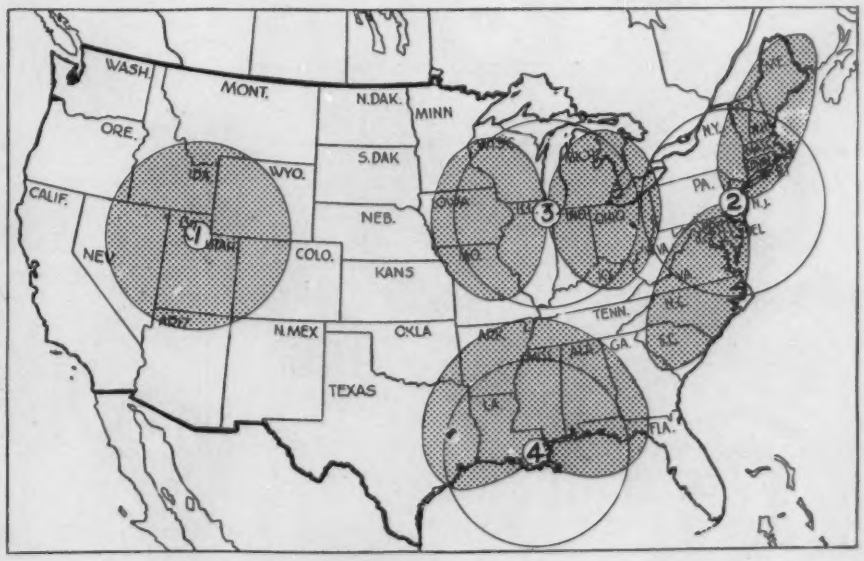
Odd-shaped field patterns result from antennas that are out of phase. Pattern number three on the map is obtained with antennas 180 degrees out of phase; by the use of choke coils in a phase-lag circuit the antennas can be thrown from one to 359 degrees out of phase.

More complicated patterns originate from systems with more elements. One station located at the base of a peninsula has a narrow beam over the tongue of land, and a wide fan covering three cities on the mainland. In addition, a local station simultaneously uses one of the towers non-directionally.

For telephone service pencils of energy are sent across the Atlantic, placing the full signal at the receiving end and being inaudible a few miles on each side. A five kilowatt station on the east coast of the United States places a strong signal in England, whereas 130 kilowatts would be required to do the same work non-directionally. Radio beacons on shipping lanes and radio range systems on airlines are other examples of directional transmitters.

— *Scientific American*



# RESEARCH IN REVIEW

## THE INSTITUTE MUSEUM

DR. KARL T. COMPTON, President of the Massachusetts Institute of Technology, has announced plans for a museum of the industrial arts and sciences which will seek not only to show the significant applications of science and engineering, but to interpret their social implications in the advancement of culture.

A unique feature of the Institute's new museum project is the plan to utilize space in its great corridors of which there are nearly three miles as well as foyers, entrances, and stairway landings, for exhibits. A good beginning already exists in the attractive and well lighted exhibition cases of geological specimens, examples of old and modern ceramic products, and apparatus demonstrating experiments in physics and chemistry, as well as the products of modern industry in these fields. The program is planned for expansion over a period of years with the objective of gradually building a museum of exceptional educational significance. Special attention will be given to interpreting the far-reaching effects on civilization of some of the familiar fundamental inventions which have revolutionized living conditions. Students as well as members of the staff will be encouraged in the making of exhibits that will contribute to educational development.

This program will be augmented by a project that will identify and explain the purpose of the more important machines and pieces of apparatus in the Institute's many laboratories. Another important objective of the program will be identification of the great men of science and engineering with their particular contributions, emphasizing in particular the vast implications of life and society that have ensued from the introduction of comparatively unimpressive inventions which have not only changed the manner of living, but the thought of the human race in a few centuries.

The nautical museum in the Pratt School of Naval Architecture and Marine Engineering is a result of the combined philanthropies of Charles Herbert Pratt, the United States government, Captain Arthur Clark, posessor of one of the best marine collections in America, and the Bostonian Society which bequeathed the famed "Hastings" collection of ship models.

## COURSE XVI — Meteorology Study

AN expedition of meteorologists from the Massachusetts Institute of Technology left for Cuba last summer to resume a hurricane research project started in the summer of 1936. The group, including Delbar P. Keily, research assistant in meteorology, and his assistant, Douglass S. Mackiernan, Jr., are operating from the Observatory of the Jesuit Society's College of Belen, in Havana. The men are being assisted by the Eastern Air Lines and American Airlines in this country and are receiving the active cooperation of the Rev. M. Gutierrez-Lanza, director of the observatory, his staff of meteorologists, and the officers of the Air Corps of the Constitutional Army of Cuba. The public utility systems of Cuba are also cooperating in the transmission of information on storm conditions and expediting the transportation of the scientists.

Hoping for better luck in their hurricane hunting than they enjoyed last year, the Technology men added ten of the latest type of radio-meteorographs to the equipment already in Havana. The radio-meteorograph is a new weather observing instrument which is sent into the upper atmosphere to record temperature, pressure, and humidity at all altitudes above the surface of the earth to a height of ten miles or more. The instruments are attached to a free balloon of rubber, inflated with hydrogen and fitted with a parachute for safe descent. These instruments have been designed to do the work of the daily weather plane at a lower cost and with greater regularity, being independent of ground weather conditions. The radio-meteorograph is especially adaptable for use over coastal and ocean regions because it is no longer necessary to recover the instrument to obtain the record. The measurements made by the instrument are sent down immediately by a small radio transmitter to a receiving set operated by the meteorologists at the ground weather station.

A constant watch for the approach of hurricanes will be

made by the Technology scientists and they will endeavor to release these instruments to the upper regions of the atmosphere before, during, and after the passage of a tropical storm somewhere over Cuba during the hurricane season. The major difficulty of the expedition is to get to the immediate vicinity of the storm in time to release the balloons so that they may ascend to the upper air levels before the storm breaks. Otherwise the balloons will be beaten to the earth before they can gain altitude.

Besides the Cuban expedition, Technology is again equiping a weather station in southeastern U. S. to carry on its investigations started there two years ago. The station, located this year in Raleigh, N. C., is again under the direction of Mr. Christos Harmantas, MIT, and is in close cooperation with three similar nearby stations operated by the U. S. Weather Bureau. The upper air sounding instruments used at these stations will be of the older self-recording type, which settle to the ground and are returned to the weather offices when found.

## COURSE VII — Food Technology Conference

SCIENTIFIC progress in the manufacture, preservation, and distribution of food were reviewed by leading authorities from Europe, Canada and the U. S. at the International Food Technology Conference held at the Massachusetts Institute of Technology from Sept. 14–17.

The conference was held under the auspices of the Institute's Department of Biology and Public Health with Dr. Samuel C. Prescott directing the program. The keynote of the whole conference was summed up in Dr. Prescott's opening speech "The Purposes of the Conference" in which he clearly stated the four objectives of the conference: "First, to bring together those interested in the real scientific advancement of the food industries whether as teachers, investigators, or manufacturers; second, to emphasize the essential fundamental unity of character of the problems of the industry since they are all concerned with the scientific control of materials, and of factors, chemical, biological, physical, or economic, which affect the usability of food by mankind; third, to present some examples of advancement in food technology along specific lines; fourth, to emphasize the importance of research and the continuous seeking for new facts and new principles capable of application in the industry." Dr. Prescott further pointed out that "the purpose of this Conference is not to call attention to the defects, failures, or narrowness of viewpoint of the past. It is, on the contrary, to stimulate a forward looking attitude and to take account of present stock in trade in the form of proved knowledge and tested experience."

The cosmopolitan group of scientists put particular stress upon the vital relation between public health and the safeguards of food manufacture and preparation. England was represented by Dr. Thomas Moran and Dr. James Pace of the Low Temperature Research Station of Cambridge University, who presented papers on the storage of food by freezing and by gas. France sent one of her great authorities on food technology, Dr. Maurice Piettre of the Institute International du Froid in Paris. The representative from Germany was Dr. Rudolph Plank, famous for his researches in refrigeration, and Dr. Louis Berube, research authority of Maritime Fisheries of Quebec was the Canadian envoy.

Practically each major phase of the food industry, one of the nation's ranking fields, received the attention of world recognized experts attending the sessions. Particular emphasis was placed upon developments in basic sciences such as biology, chemistry, physics, economics, and engineering, and how these were linked with production, handling, transportation, manufacture, processing, and ultimate distribution to consumers. Advances in dairy technology, progress in air conditioning of manufacturing plants engaged in the canning or packaging of food stuffs, effect of extremely low temperatures, spoilage control in the canning industry, vitamin content of quick frozen and refrigerated foods were topics which were presented at the meetings.

Following the Wednesday morning session the group of food technicians were guests of the Dewey and Almy Chemical Co. for a visit at the company plant in North Cambridge, and a luncheon.

A few of the highly informed conference speakers and their subjects of address were: Professor George R. Harrison of Technology spoke on the "Use of the Spectroscope in Food Research"; Professor Robert S. Williams, head of the Institute's Department of Metallurgy, presented a paper on "Research in Metallurgy and its Significance in Canning"; H. A. Barnby, Director, Packaging Research Division of the Owens-Illinois Glass Co. delivered "Food Preservation in Modern Glass Containers"; W. E. Taylor, Vice President of the American Can Co. presented "The Development of a New Container—the Beer Can"; Professor S. C. Prescott, Dean of Science of The Massachusetts Institute of Technology spoke on "Certain Microbiological Aspects of Frozen and Refrigerated Foods"; Dr. William H. Harrison, Director of Research Dept. of Continental Can Co., presented "The Research Problems of the Can Manufacturer."

## COURSE V — Chemistry

PROGRESS at the M. I. T. in new studies in the range of the lowest attainable temperature has reached the pages of the Journal of the American Chemical Society. The August, 1937 issue contains the first paper of a projected series of communications in this field. It is under the joint authorship of F. G. Keyes, H. T. Gerry, '29, and J. E. G. Hicks, all of the staff of the Department of Chemistry. The title of the paper, "The Production of Liquid Hydrogen without Expensive Equipment," tells the story of the importance of the method.

The older and standard method for liquefying hydrogen and helium requires an array of compressors, gas tanks and, in the case of hydrogen, generators. This apparatus is expensive both from the standpoint of initial cost and of operation. The expense has been one of the most serious difficulties in the development of low temperature research even in the United States with its large quantities of helium which ought to invite such research.

The five practical methods of refrigeration recognized are:

(1). The expansion of fluids with the performance of external work,
(2). The expansion of fluids from a high pressure constant-volume container,
(3). The Joule-Thomson expansion of fluids,
(4). The desorption of gases from such absorbents as activated charcoal,
(5). The magnetic- and electric-susceptibility changes of state.

This first paper sketches the theory of liquefaction by the JOULE-THOMSON effect and describes improvements in that part of the apparatus known as the interchanger-liquefier. Pre-cooling, necessary for this method, is accomplished by means of liquid nitrogen, now readily available. Ordinary commercial hydrogen, obtainable in tanks at 2000 pounds pressure, is satisfactory for the process. Glass, formerly employed for the required apparatus, has been replaced by metal with attendant improvements in the economy of refrigeration. The results, thus far obtained, demonstrate the success of the newer technique and liquid hydrogen, at relatively moderate costs, has become available for research purposes. This work in refrigeration is being carried forward as one of the major projects of the Research Laboratory of Physical Chemistry.

# SCIENTIFIC RESEARCH

(*Continued from page 119*)

man Research Laboratories, and many others. Most of these laboratories carry on research of a fundamental as well as of an applied nature. This is perhaps contrary to what you would expect, but the fact is that they are placing as much emphasis on fundamental problems, which possibly in the future will lead to successful commercialization, as on problems expected to have immediate practical application.

Thus a prominent leader in the research laboratories of the General Electric Company has said, "If research is of a character to yield new knowledge in fundamentals, there is little need to worry about immediate practical applications. They may be trusted to appear in good time." Hence there are plenty of opportunities also in the industrial laboratories for the scientifically-inclined research man who is interested in knowledge for knowledge's sake. As a matter of fact, a large portion of their staffs consists of such men. Then there are in addition those who deal more directly with the immediate application type of project. It is of course clear that the industrial laboratory's interest in fundamental research is not altruistic, as is also evident from the quotation just made. Their firm expectation, based on past history, is that it is the fundamental researches which give rise to the really big opportunities, in that their results may lay the foundation not only for major improvements in present products but for entirely new products as well. Thus, taken over a period of years, the investment in fundamental research may prove many times as profitable as that put into researches specifically designed to yield more immediate practical applications.

All the departments at Massachusetts Institute of Technology are active in research, although perhaps not all to the same extent. The publications previously quoted testify to the comprehensiveness of this research. The number of publications, however, is not by any means indicative of the number of projects which are under way at any one time, so it may be that a limited number of additional statistics may be interesting at this point. The most recent figures in my possession with respect to the Institute as a whole, date back to April, 1934, the record at that time showing that 447 research projects were under way. In these figures, however, only items which were considered of real scientific or professional importance are counted. They include researches sponsored by the departments themselves, researches by staff members and doctorate students, but only a fraction of the Master's theses. There are, to my knowledge, no undergraduate theses included.

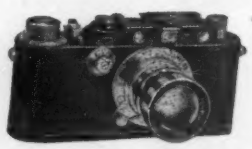
A comparable number of projects are being worked on each year and, in fact, are under way right now. If you walk around in the laboratories you cannot avoid running into them. As newcomers to the Institute, it would only be natural for you to scout about a bit within the buildings in order to get the "lay of the land" and to become familiar with what normally will be your work-place for four consecutive years. This will reveal the existence of many of the research projects, and you will recognize, I am sure, wholly apart from the few statistical figures I have presented, that there is considerable research going on in this Institute. As a matter of fact, we are justified in putting it much more strongly — *plenty is going on, and much is real important investigation.*

With respect to these research activities, there is particulary one idea I want to emphasize and definitely leave with you: The objective of our research is not only to advance knowledge and contribute to the art, science and engineering, *but its objective is also to be a forceful educational factor.* Or, differently expressed, *our research should occupy a definite place and play a vital part in the Institute's educational process.*

It is partly there for *your sake.* It provides a unique environment for your education, and you should take maximum advantage of this fact. This devolves upon you, and it is your own fault if you don't.

The laboratory tour suggested above you may and should repeat from time to time during your undergraduate career. You would naturally pay particular attention to the department in which you major and to what is going on therein. The doors are open. Use your eyes; be keen and observing, and learn from what you see. Also use your ears, however. Inquire and listen. Ask questions of those who conduct researches, whether they are staff members or older students. They will be glad to answer reasonable questions and help satisfy sound and serious mental curiosity.

The Institute is not static — satisfied to rest upon its laurels and past accomplishments. On the contrary, it is a highly dynamic place, constantly endeavoring to be in the forefront of scientific and technical knowledge as well as in education within its fields. It is in a position to give you much, but you yourselves must co-operate. You must show the right attitude and get into the spirit of things. The research activities in all their ramifications should, and I hope definitely will, stimulate you and help implant in you the research spirit — the spirit of inquiry. This spirit will be important to you not only here, in making your studies interesting and fruitful, but equally as well later in your professional life. It is undoubtedly safe to say that no engineer will rise to prominence unless he, among other qualifications, also possesses the spirit of inquiry — the desire to establish the truthful facts in any problem or situation he may encounter. Again, therefore, make all the use you can of the research environment the Institute offers and permit it to play a real part in the education you are here to secure.

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## TRAINING vs. EDUCATION

(*Continued from page 120*)

The idea of a liberal curriculum does not find favor with some technical schools. They say that culture is the problem of the secondary school and the liberal arts college. In the technical school all the student's energy must be concentrated on the basic techniques of his profession if he is to meet the exacting demands of modern industry. This is only a half-truth, since the technical schools alone require no pre-professional courses of college grade; and certainly the high school student is too immature to gain the fullest benefits from the arts, social studies, and related extra-curricular experiences. Furthermore, one has only to examine critically the personal and cultural make-up of some of his engineering acquaintances to realize how inadequate many of them are to function either personally or professionally in the bewildering complexities of modern life. Also, it seems to be true that large numbers of engineering specialists use comparatively little of their technical equipment in their later work, but find themselves in one of a vast variety of administrative and executive positions, the research being done by men who have engaged in rather extensive graduate study. The writer recalls hearing Dean Tyson remark to a group of preparatory school boys that English is the most important subject given at Massachusetts Institute of Technology. This is a perfect illustration of the urgent need engineers have for the non-technical aspects of their education. It might not be inappropriate to suggest that a thorough investigation of some of the present engineering curriculums would result in a number of valuable omissions and substitutions. The newer courses in administrative engineering are a step in this direction.

If, then, the engineer is to be a citizen as well as a craftsman, he should concern himself with four aspects of cultural growth in addition to the acquisition of technical skill. These aspects have been described as *critical thinking*, which is another name for good judgment; *co-operation; aesthetic taste*, broadly interpreted to mean a sense of values; and *physical and mental health*. These are the qualities which if developed, should enable the graduate engineer to realize richly on his investment of time and money; to utilize for the good of himself and society his technical skill.

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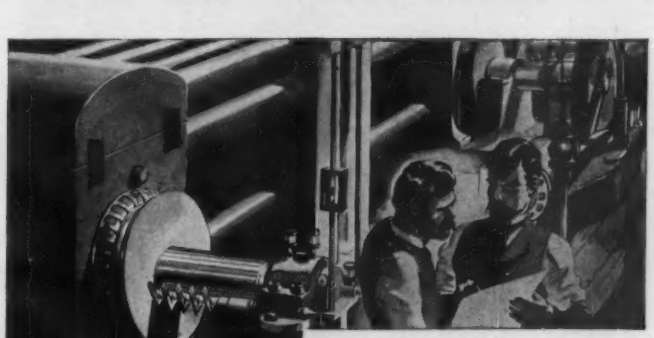

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# THE DIESEL ENGINE

(*Continued from page 125*)

in automobiles. A few examples will show the great possibilities of the Diesel in the automobile. In 1930 a seven-passenger sedan made a run of 792 miles from Indianapolis to New York at a cost of $1.38 for fuel. In 1931 a 17,000 pound truck, powered by a Diesel motor designed by C. L. Cummins, made a coast-to-coast speed record in a run of 3,124 miles from New York to Los Angeles. The total time of the run was 97 hours and 20 minutes at an average speed of more than 33 miles per hour. Eleven dollars and twenty-two cents or .1 cent per ton-mile of pay load was the total cost. This same truck was later taken to the Indianapolis speedway and was driven for fourteen days and nights without the engine being stopped. Fourteen thousand six hundred miles of track were covered, of which 13,335 were run without stopping the truck, while 10,005 miles elapsed without refueling. The average speed of the run was 43 miles per hour, at a cost of less than .5 cents per mile. A year later a 10½ ton bus with a six-cylinder Diesel engine made a trip from New York to Los Angeles in 78 hours and 10 minutes, at an average speed of more than 41 miles per hour. Three hundred sixty-five gallons of fuel were consumed at a cost of $4.65, or an average cost of .68 cent per mile. Some automobile engines have been stepped up to 3000 R. P. M., and speeds of ninety miles per hour have been attained. If the demand develops, it is entirely possible to have a Diesel-powered car that can travel 40 miles on a gallon of fuel oil, at a cost of about five cents. There is no doubt that mass production can bring the cost of the Diesel to the range of the ordinary man. Such a move would eventually result in the saving of many dollars worth of fuel, a boon to present and future generations of car owners.

All through this paper, the various advantages of the Diesel have been pointed out. A brief resume of these will doubtless be valuable now. The Diesel is more reliable than the gasoline engine, because it has no electric ignition system. Fuel consumption is at least twenty per cent less by weight than with the gasoline engine. Diesel engines require no more attention than gasoline engines, while neither temperature humidity affects their operation. They have better torque at lower speeds, and faster pick up, and there is absolutely no fire hazard with Diesels as their fuel is not explosive. With all these enumerated advantages, is it any wonder that the Diesel is fast becoming a commonplace piece of apparatus? Its development will doubtless continue at the present rate, thus insuring better transportation at lower costs.

| | *Gas* | *Light-Oil* | *Medium-Oil* | *Heavy-Oil Low Compression* | *Diesel* | *Heavy-Oil High Compression* |
|---|---|---|---|---|---|---|
| Fuel | Town Gas | Gasoline | Paraffin | Petroleum Dist. | Petroleum Residual | Same as Diesel |
| Material Drawn into Cylinder | Gas-Air Mixture | Vapour-Air Mixture | Same | Pure Air | Pure Air | Pure Air |
| Compression Pressure Lb. Sq. In. | 120 | 85 | 80 | 60 | 480 | 360 |
| Compression Temperature Degrees F. | 570 | 350 | 330 | 305 | 940 | 740 |
| Method of Vaporization | —— | Carburetor | Separate Vaporizor | Hot Surface Heat of Compr. | Heat of Compr. | Same as Heavy-Oil Low-Compr. |
| Method of ignition | Spark | Spark | Spark | Compr. | Compr. | Compr. |
| Thermal eff. % B.H.P. | 25.3 | 22.9 | 21.2 | 18.9 | 33.7 | 32.9 |


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# EDITORIALS

(*Continued from page 127*)

## *SMOKE*

ONCE again, as the winter months approach, it will envelope the industrial cities in a smudgy haze, and renew the attack on property and health that it discontinued last spring. Some cities have enacted ordinances in efforts to control the smoke problem. However, in many cases, these ordinances are incomplete or difficult to enforce, and, as such, do little good. That every community faced with this problem has not rigidly provided for its elimination is indeed regrettable, and is merely another inconsistency of a civilization that proverbially strives for sanitation and, perhaps, economy.

Smoke is not only wasteful; it is also destructive. Not only is it largely unburned fuel, but it carries with it corrosive gases, including those that form sulfurous and sulfuric acids when in contact with moisture. The acids slowly attack the exposed metal in buildings, bridges, and other structures, thereby reducing their strength. The surface of unpainted steel girders scales off, holes appear in steel plates, and rivet heads are eaten away, until only constant repair work and painting can counteract the destruction. Replacements of steel smoke-stacks add to the unnecessary expense. Steel is not the only metal attacked, for an investigation by the Mellon Institute disclosed that iron, tin, copper, and even bronze have much shorter lives in smoky cities than in clean ones.

Smoke-polluted air is also believed to have an adverse effect on health. Constant breathing of the injurious sulfur compounds, found not only as separate gases, but also adhered to the carbon particles of the smoke, irritates the respiratory system. An experiment was performed in which two groups of white rats, one living in an air-conditioned room, the other in the atmosphere of a large mid-Western city, were observed through several generations. The results indicated that the rats in the city's atmosphere were generally less healthy and had a higher mortality rate than those in the clean air. After death, the rats who had breathed conditioned air were found to have normal, pink lungs, whereas the others possessed gray, discolored bronchial tubes and lungs. Smoke aggravates, if it does not cause colds, sinus infections, pneumonia, and other respiratory ailments. And in England there were 18.9 per cent more deaths of children under one year of age in cities, where the smoke is concentrated, than in rural districts.

What is to be done about this threat to property and health? In cities, in some of which the annual dirt and soot settlement per square mile is 1,000 tons, most leading business men seem willing to co-operate with authorities in efforts to reduce smoke from their factories and buildings to a minimum. But they cannot do it alone. The other inhabitants of the community must help, either willingly or through law.

This latter method would seem to be the more reliable—have effective city ordinances requiring proper stoking of fuels so treated as to give a minimum of smoke.


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# AVIATION INSURANCE

(*Continued from page 122*)

7. General policies of the company in relation to personnel
8. Attitude towards technical improvements, care with which new developments are studied before being used. Organization and personnel of research department
9. Financial condition of the organization
10. Operating records, including accidents, mechanical failures, forced landings, etc.

A survey conducted a few years ago would be of little value today because aircraft have higher cruising speeds, greater range, fly at higher altitudes, and, though easier to maintain have more to be maintained. Also, the development of instrument flying, the automatic pilot, more accurate weather forecasting, and more efficient ground facilities create quite a different picture. It should be remembered that technical improvement does not necessarily mean greater safety or reduced risk from the underwriter's viewpoint. Flaps, for instance, have not reduced landing speeds; they enable greater crusing speeds for the same landing speeds. Instrument flight means increased chances of collision in the air, larger airplanes mean more people exposed to injury per flight.

Before an airline is insured, the engineer endeavors to give the underwriters all this information. Then, after the airline is insured, he does as much as time allows to keep the risk "sweet." This is accomplished by periodic surveys, by advising the management of good practices found elsewhere, by trying to cooperate with the insured company, and with the regulatory agencies such as the Bureau of Air Commerce in every way.

Every type of aviation insurance, whether it be the charter operator, or an airliner, or test risk, require separate study to determine the risks, and co-operations to reduce them. From what has been described before, you can see that a definite statement of all the duties of an aviation insurance engineer would be impossible because there are too many ramifications. It is sufficient to say that the engineer tries to give the underwriters the information they need to rate risks intelligently, and he tries to reduce the losses as much as possible. Fortunately both these activities are as much help to the assured as they are to the insurance companies. The aviation insurance engineer likes to feel that he is of definite constructive help to the whole aviation industry.


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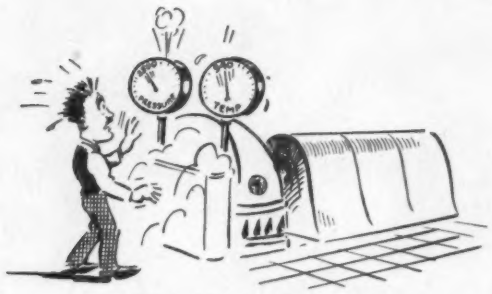
Thanks to the teamwork of these Bell System units, you can talk to almost anyone, anywhere, anytime—at low cost!

# G-E *Campus News*

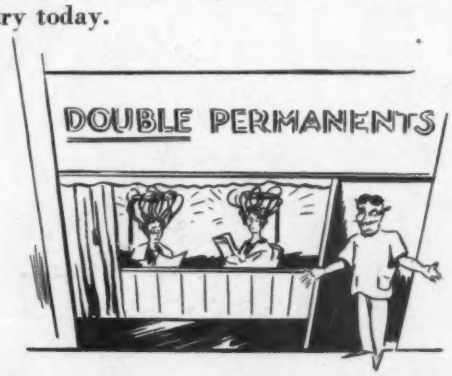


### IT'S THE "TOPS"

A turbine-generator set now being built at the Schenectady Works of the General Electric Company will operate at a pressure of 2500 pounds and at a temperature of 940 F. This pressure is nearly 1000 pounds more than that used for any other commercial unit now in service, and the temperature is higher.

It represents the work of many men. Experts in mechanical design have solved unique problems—for the shell of the turbine will have to withstand pressures equal to those more than half a mile below the surface of the sea. When the unit is completed, electrical and chemical engineers, metallurgists, and research workers will have contributed knowledge and experience to it.

The design and construction of turbine-generators such as this is largely the work of college graduates—many of whom entered G-E Test only a few years ago. Thousands of other Test men are engaged in the design, manufacture, and sale of these and hundreds of other electric products that are used in industry today.




### TWO PERMANENT WAVES AT ONCE

Co-eds preparing for a dance are not the only subjects for permanent waving—there is the tungsten wire used in General Electric lamps.

This wire, 19/10,000 inch in diameter, is first tightly wound, 335 turns to the inch, with the coils 1/1000 inch apart. After the wire receives this first "permanent wave," it is coiled once more, 70 turns to the inch, with 7/1000 inch between the turns. This reduces the original 20 inches of wire to a coil 5/8 inch long and having an outside diameter of 310/10,000 inch.

These permanent waves pay real dividends in increased efficiency because tungsten wire becomes more brilliant as it is more closely compacted. This new process is only one of many developments made by G-E engineers in the field of illumination—a field which offers many opportunities for technically trained men.

### WELDING IN THE ARCTIC

A broken gear wheel recently threatened to shorten the 100-day working season of a group of miners on the Alaskan tundra, above the Arctic Circle. No time could be lost, for in early September the ground would be frozen solid.

There was but one chance to save the season's work. The gear wheel was loaded in an *umiak*—a native boat made of skins—and for five days an Eskimo crew paddled to the settlement of Candle, where the Arctic Circle Exploration Company had a General Electric gasoline-driven arc-welding set. Three hours after their arrival, the Eskimos were ready to return with the repaired wheel. Instead of the ruinous loss of a season's work, the interruption lasted only two weeks.

Opportunities for G-E products to be of service to industry occur in all parts of the world, and General Electric has built up an extensive international organization to meet those needs.

90-7DH

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